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ABSTRACT

The purpose of this study was to replicate previous factor analytical studies of the Wechsler Intelligence Scale for Children-Revised (WISC-R) employing children identified as gifted. However, rather than using the IQ criterion, a child's 11 WISC-R subtest scores were included in the analysis. Subsamples of gifted (as classified by local school districts) and average children were created from 599 WISC-R protocols contributed by 25 school psychologists. A Principal Components Factor Analysis with a Varimax rotation yielded different factor solutions: (1) the average sample yielded two factors, verbal ability and perceptual organization, which are consistent with Weschler's findings; and (2) the gifted sample yielded four factors, identified as perceptual organization, verbal ability, acquisition of knowledge, and alertness and attention to detail. These differences in factor structures suggest major differences in the cognitive processes of gifted and average students. Gifted program selection procedures focusing only on IQ scores may be inappropriate. (BS)

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A Reanalysis of the WISC-R Factorial Structure of Gifted Children

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Running head: A REANALYSIS OF THE WISC-R FACTORIAL STRUCTURE OF GIFTED CHILDREN

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Abstract

The purpose of this study was to attempt to replicate previous factor analytical studies employing children identified as gifted. However, rather than using the IQ criterion, a child's WISC-R subtest scores were included in the analysis if the child had been identified by the school district as gifted. A Principal Components Factors Analysis with a Varimax Rotation yielded a four-factor solution accounting for 65.6% of the total variation. Significant factors were identified as perceptual organization, verbal ability, acquisition of knowledge and alertness and attention to details. By examining this solution, possible implications for identifying gifted children are explored.

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A Reanalysis of the WISC-R Factorial Structure of Gifted Children

Though central to psychology, intelligence testing continues to be one of the most controversial fields of assessment. A great deal of research has been conducted examining the standardization, administration, and interpretation of group and individually administered intelligence tests. Currently, the Wechsler Intelligence Scale for Children - Revised (WISC-R) - yielding a Verbal, Performance and Full Scale Intelligence Quotients (IQs) - is the most frequently administered individualized intelligence test (Sharp, 1984).

Factor analytical studies of the subtests of the WISC-R using both heterogeneous and homogeneous samples are numerous. The majority of the research involving the complete WISC-R standardization group and other large samples of heterogeneous subjects has generally supported the existence of two factors, verbal ability and perceptual organization (Wechsler, 1974), and occassionally a third factor identified as freedom from distractiblity (Kaufman, 1975) (see Appendix A for details of the Kaufman factors) or sequencing (Rugal, 1974). Additionally, there have been many studies involving samples of subjects with characteristics such as learning disabilities (Lombard & Riedal, 1978; Lowrence, 1977; Rugal, 1974) and emotional impairments (Peterson & Hart, 1978).

A study employing factor analytical techniques was conducted by Schooler, Beebe and Koepke (1978) with nearly 800

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children classified as learning disabled, educable mentally impaired, emotionally impaired and no disability. Their analyses yielded a similar factor solution for each of the four classification groups. These results suggest that although there may be differences in the subtest scores for each group, the subtest score patterns of responses are very similar.

Until recently, the gifted and talented student has been excluded from the majority of the research with the WISC-R. Yet, many communities and states require cut-off levels of WISC-R IQ scores that must be achieved by students prior to admission to a gifted and talented program (Fox, 1981). On the other hand, there is a great deal of literature proposing that the use of strict cut-off criteria for entrance to gifted and talented programs be terminated (Renzulli, Reis & Smith 1981). Renzulli, et al. have argued that there are other critical components of giftedness that are not assessed by intelligence tests such as the WISC-R.

Factor analytical studies of gifted children have focused on the patterns of subtests for indications of variations in cognitive processing compared with the two-factor solution of Wechsler (1974). Several studies of children identified as gifted have used a cut-off point of a IQ score greater than 119 on either the Verbal, Performance or Full Scale components of the WISC-R (Brown & Rood, 1982; Karnes & Brown, 1980; Willson, Gilberg & Reynolds, 1982).

Karnes and Brown (1980) reported the existence of both a two-factor structure that parallels the Wechsler (1974) Verbal -

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Performance dichotomy and a three-factor Varimax solution that conforms to the structure reported by Kaufman (1975). Based on their findings, Karnes and Brown concluded that there does not appear to be a fundamental qualitative difference in the manner in which gifted and nongifted children process information. Gifted children just score higher on the individual subtests.

In an attempt to replicate the findings of Karnes and Brown (1980), Willson et al. (1982) performed a factor analysis on a sample of 362 subjects from the standardization sample of the WISC-R and on 57 multi-ethnic subjects from a sample drawn from an earlier study (Reschly, 1978). Using the identical criterion for giftedness as Karnes and Brown, the factor solution yielded a single factor that the authors identified as verbal ability.

Recent research conducted by Brown and Rood (1982) has also suggested that there may be a substantially different factor analysis solution for gifted and nongifted children. Their investigation of the WISC-R subtest scores of a small sample of 52 gifted subjects resulted in a 4 factor solution. These four factors were tentatively identified as verbal ability, perceptual organization, gestalt, and freedom from distractibility. Their factor loadings (see Appendix B), though unstable because of the small sample size, appear to suggest the need for further research.

The research of Karnes and Brown (1980), Willson et al. (1982) and Brown and Rood (1982), appear to be in conflict, and are therefore, unable to resolve the central question. Thus, the purpose of the present study was to attempt to address the fundamental issue of WISC-R factor patterns of the gifted: Are

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they different from other groups? If gifted children have a similar factor solution pattern to other populations and only achieve higher scores, then Verbal, Performance and Full Scale IQ scores may provide valuable information in the identification of gifted children. However, if a different factor solution pattern exists for gifted children, then the IQ scores may not be as important as the pattern of the WISC-R subtest scores in the identification and selection of gifted children.

Method

Subjects

Twenty-five school psychologists from New York and the New England region contributed a total of 599 WISC-R protocols. From this sample a sub-sample was created consisting of 120 children that had been classified as gifted by local school district based on local criteria. A sub-sample of average children was also created. These children were not identified as gifted or placed in any category within special education.

Demographic data showed an equal distribution of sex and age range (66 to 198 months). Means and standard deviations of each of the samples are presented in table one.

Insert Table 1 about here

Procedure

All WISC-R data were submitted by practicing school psychologists and graduate students enrolled in the school

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psychology program at the University of Connecticut. The age, sex and special education classification (if any) determined by the school system and the scaled scores for each of the subtests of the WISC-R, were collected for each subject. All data were then coded and a factor analysis was conducted on each sub-sample.

Results

The means and standard deviations of the ten mandatory subtests and the optional subtest, Digit Span, were calculated. A correlation matrix of these subtests generated many significant univariate correlations. A Principal Components Factor Analysis with a Varimax rotation for each sample was employed to examine the underlying constructs (Nie, Hull, Jenkins, Steinbrenner, & Bent, 1975). A factor was considered significant, and hence retained, if the eigen value exceeded one. A loading defining a factor at least .40 (either +.40 or -.40) was interpreted as significant.

Average Subjects. The factor analysis for the average sample yielded a two factor solution accounting for 60.1% of the total variance. The two factors, verbal ability and perceptual organization, are consistent with the earlier findings of Wechsler (1974). A complete listing of the subtests and the loadings of the factors are presented in table two.

Insert Table 2 about here

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Gifted Sample. A four-factor solution accounting for 65.5% of the total variance emerged for the gifted sample. A factor identified as perceptual organization had significant loadings from Object Assembly, Block Design, Picture Completion, and Picture Arrangement. The second factor, verbal ability, had significant loadings from Comprehension, Similarities, Vocabulary and Information. Arithmetic, Information, Coding and Vocabulary, loaded on factor three - acquisition of knowledge. The final factor, attention and alertness to detail, had significant loadings from Digit Span, Picture Completion and Arithmetic. Table 3 presents a summary of the factor solution and the loadings of each of the subtests for the gifted group.

Insert Table 3 about here

Discussion

The results of the present study are congruent with the earlier findings of Wechsler (1974) with respect to the average sample, however, they are in opposition to the findings of Karnes and Brown (1980) and Willson et al. (1982) with respect to the gifted sample.

The results of the factor analysis of the gifted sample appear to suggest that there exists a major difference in the manner in which gifted subjects process information from those that are not gifted, as indicated by major differences in the factor solutions obtained for the two samples as originally proposed by the earlier work of Brown and Rood (1982).

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If the subjects in the gifted sample are conducting mental processing in the same manner as the nongifted group but, just scored higher, then the factor solutions for each group should have been identical. Merely higher scores on the WISC-R subtests for the gifted sample would not have resulted in a factor solution different from those identified by Karnes and Brown (1980), Wechsler (1974), or Kaufman (1975).

If as the present study suggests, there exists a major difference in the cognitive processing of children identified as gifted from those who are not, then the use of WISC-R cut-off levels for the Verbal, Performance and Full Scale IQs may be an inappropriate method for selecting students for participation in gifted programs. A better selection system may be developed by examining the four-factor solution of the present study and focusing on the performance of students on specific subtests and patterns of subtests comprising these factors.

Though the present results are not ready to be employed for selection procedures without further examination, the implications and ramifications for selection procedures and for models of the cognitive processing of gifted children are apparent. Gifted children qualitatively and quantitatively mentally process information differently than average children and therefore, selection procedures for gifted programs focusing only on IQ scores are inappropriate.

Further research replicating these results with separate samples of gifted children and children with superior IQs may lend additional information to the identification and selection

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process, and models of cognitive processing.

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Table 1

Means and Standard Deviations of the WISC-R Subtests and Scales for the Total Sample and the Average and Gifted Sub-samples

Subtest	Total Sample Mean (SD)	Average Mean (SD)	Gifted Mean (SD)
Information	10.87 (4.11)	11.88 (3.70)	14.63 (2.66)
Similarities	11.70 (4.21)	12.55 (3.57)	16.18 (2.39)
Arithmetic	10.60 (3.85)	11.52 (3.71)	13.82 (2.83)
Vocabulary	10.98 (3.97)	11.69 (3.68)	15.03 (2.61)
Comprehension	11.78 (3.83)	12.47 (3.41)	15.25 (2.73)
Digit Span*	12.82 (3.18)	10.18 (3.53)	12.71 (3.41)
Picture Completion	11.46 (3.10)	12.00 (2.65)	13.40 (2.66)
Picture Arrangement	11.47 (3.51)	12.12 (3.26)	13.35 (2.53)
Block Design	11.30 (3.93)	12.25 (3.45)	14.77 (2.81)
Object Assembly	11.44 (3.35)	11.99 (2.99)	13.67 (2.67)
Coding	9.95 (3.64)	11.03 (3.61)	11.95 (3.01)
Verbal IQ	107.36 (22.32)	112.25 (19.67)	131.58(12.21)
Performance IQ	107.97 (19.05)	113.23 (16.23)	124.22(11.99)
Full Scale IQ	108.49 (21.50)	114.14 (18.20)	131.25(11.47)

* Digit Span is an optional subtest on the WISC-R. The number of subjects with the Digit Span subtest is 462, 154 and 66 for the total sample, Average Sub-sample and Gifted Sub-sample, respectively.

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Table 2

Factors and Loadings From the Varimax Solution for Subjects Classified as Average Accounting for 60.1% of the Variance

Subtest	Verbal Ability	Perceptual Organ.
Information	.80*	.35
Similarities	.73*	.40
Arithmetic	.73*	.36
Vocabulary	.76*	.33
Comprehension	.70*	.29
Digit Span	.69*	.00
Picture Completion	.19	.68*
Picture Arrangement	.23	.63*
Block Design	.34	.70*
Object Assembly	.08	.73*
Coding	.38	.59*

* Indicates significant loading of + or - .4 or greater.

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Table 3

Factors and Loadings From the Varimax Solution for Subjects Classified as Gifted Accounting for 65.6% of the Variance

Subtest	Percep. Organ.	Verbal Ability	Acquis. of Knowledge	Attention to Details
Information	.33	.43*	.67*	.09
Similarities	.09	.80*	.07	.00
Arithmetic	.06	-.11	.76*	.11
Vocabulary	.22	.64*	.44*	-.13
Comprehension	.01	.80*	.04	.24
Digit Span	-.02	.06	.19	.87*
Picture Completion	.58*	.31	-.34	.47*
Picture Arrangement	.46*	.18	.18	.30
Block Design	.78*	-.02	.06	-.05
Object Assembly	.86*	.09	.01	-.06
Coding	.03	.13	.54*	.00

*Indicates significant loading of + or - .4 or greater.

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Appendix A

Factor Structure for WISC-R Subtests Proposed by Kaufman*

VERBAL COMPREHENSION	PERCEPTUAL ORGANIZATION	FREEDOM FROM DISTRACTIBILITY
Information	Picture Completion	Arithmetic
Similarities	Picture Arrangement	Digit Span
Vocabulary	Block Design	Coding
Comprehension	Object Assembly	
	Mazes	

* Adapted from Kaufman (1979).

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Appendix B

Factors and Loadings from the Varimax Solutions for Children Classified as Gifted for the Brown and Rood (1982) Study*

Subtest	Verbal Ability	Gestalt	Percept. Organ.	Freedom from Distract.
Information	.80*	-.01	.00	.05
Similarities	.65*	.26	-.26	.18
Arithmetic	.05	-.08	.18	.88*
Vocabulary	.78*	-.14	.14	-.02
Comprehension	.49*	.00	-.36	.52*
Picture Completion	.39	.59*	.16	-.28
Picture Arrangement	-.05	.87*	-.15	-.08
Block Design	-.09	.21	.67*	-.04
Object Assembly	.13	-.19	.78*	.15
Coding	-.19	.68*	.46*	.33

* A Full Scale IQ exceeding 124 was used as the criterion for identifying a subject as gifted. The total N=52.

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Author's Notes

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